
NUTRIENT RECOVERY HELPS FAIR OAKS DAIRY FARM STAY ON THE INNOVATION CURVE.

Advanced Nutrient Management Technology



By Richard Shatto

Few farms in North America are as recognized as Indiana's Fair Oaks Dairy Farm. And, size does have a lot to do with it. Located just off the interstate south of Chicago, Fair Oaks Dairy Farm sits on over 15,000 acres (24 square miles) and shepherds over 15,000 cows. That's enough to produce 2,500,000 glasses of milk every day, nearly a glass each for the entire population of Chicago.

One might think such a large farm would be unapproachable by the public but Fair Oaks Dairy Farms - South Dairy hosts over 160,000 visitors annually. Visitors ride in tour buses through the center of the cow barns and get to view much of the farm's dairy operations.

Fair Oaks Dairy Farms, along with its six neighboring family farms are the founding farms of Fair Oaks Farms, the nation's largest agritourism attraction. Together with the Fair Oaks Farms Pig Adventure (home to 3000 sows) and the soon-to-open Winfield Solutions Crop Adventure, Fair Oaks Farms hosts more than 500,000 visitors annually. The tours educate, entertain and share the wonders of modern agriculture. Located centrally between Chicago and Indianapolis and situated directly on Interstate 65, Fair Oaks Farms has 28 million potential visitors within 200 miles. Those visitors, most of whom have never set foot on a farm, get a first-person view of many aspects of one of America's most innovative dairy and hog

operations; experiencing the real-world of modern farming.

IN THE SPOTLIGHT

Such close attention by the public has reinforced Fair Oak Dairy Farm's management to pay heed

Member and Officer of the National Producers Federation, the Chairman of the Sustainability Initiative of the Innovation Center of U.S. Dairy, and the CEO of Select Milk Producers. Those positions provide him with a distinct perspective on the needs of both his farm and the industry.



to the myriad of issues that can affect the farm as well as the dairy industry as a whole.

“We work hard to understand how issues might affect us not just today, but in 3, 5 or 10 years from now,” says Carl Ramsey, Digester Operations Manager at Fair Oaks Dairy Farm. Indeed, it’s a practical strategy that has helped Fair Oaks Dairy Farm stay ahead of the proverbial curve.

And, stay ahead they do.

Dr. Mike McCloskey, a Doctor of Veterinary Medicine with a specialty in farm animal production from the UC Davis, provides leadership and inspiration to his farm and the industry. He is a partner in Fair Oaks Dairy Farms and is one of the founders of Fair Oaks Farms. He also serves as a member of numerous industry related boards including Board

One area of operations getting a lot of attention these days is manure and the developing solutions for managing it.

MANURE MANAGEMENT

“Of the many components of dairy farming, manure management isn’t my personal favorite,” says Dr. McCloskey. “But, for many reasons it is an area we’ve dedicated a lot of strategic thought and resources to. Over the years, we’ve discovered getting manure management processes right, can pay dividends.”

Indeed, they have.

In 2005, to produce its own renewable electricity, Fair Oaks Dairy Farms installed a bio-reactor to digest the manure from 3,000 of its cows. That system was capable of producing

enough energy to power the dairy barn operation and the theme park's Visitor Center, or the equivalent electricity for 700 homes.

Encouraged by its success, in 2008, they installed a second larger and more efficient digester. It produces double the energy output of 1,200,000ft³ of biogas daily. With additional conversion technology, it is providing enough compressed natural biogas (CNG) to power the farm's fleet of 42 tractor-trailers that haul the local dairies' milk to markets throughout the Midwest. In effect, this renewable CNG annually displaces 2 million gallons of conventionally produced diesel fuel. After that, there is still enough biogas left to produce an additional one-megawatt of electricity.

MANURE DOESN'T JUST DISAPPEAR

Though the digesters have successfully produced renewable energy and helped reduce overall operational costs, they don't make manure disappear. Nor do they lessen the processes required to manage the manure or its reuse as fertilizer.

"Manure handling has always been a pure cost," states Dr. McCloskey, "Even, though our digesters helped make our manure more of a resource, the myriad processes for handling the manure still take up an oversized slice of our resource pie."

For centuries, farmers have used the practice of applying manure to their fields to fertilize their crops. But, today with the increased nutritional demands of a hungry planet and the ability to use the efficiencies of intensive farming there is an added awareness associated with agricultural nutrients. High concentrations of nutrients can have adverse effects on land and water. Nutrients can leach into water tables or

run-off into waterways and overwhelm an ecosystem's natural balance. As the impact of nutrient-related risks has become better understood, regulators have begun to apply increasingly restrictive regulations regarding the handling, storage, use, transport and discharge of manure. In turn, those regulations can severely impact a farm's overall operations, escalating manure management costs.

As a solution, today's farmers are adopting new, innovative technologies. One of those is nutrient recovery, a topic being discussed at ag-conferences and around farmer's kitchen tables around the globe.

NUTRIENT RECOVERY

Nutrient recovery is the process of segregating and capturing the major nutrient components (fertilizer) in manure: nitrogen, phosphorus and potassium (NPK) and converting it to a more



Two 400ft² DAF tanks float the nutrients where they can be skimmed off and converted into dry, stackable fertilizer.

accessible, usable format. That may not sound like a big deal, but according to Fair Oak managers, it is a game changer for dairy manure operations.

Consequently, Fair Oaks' management initiated a search for a technology that could process and convert the farm's manure (digestate¹) into a natural fertilizer concentrate. "We recognized the benefits that adding nutrient recovery to our manure management systems would bring," says Ramsey, who was tasked with evaluating different nutrient recovery systems. "We visited sites where nutrient recovery technologies were being piloted and the Trident system stood out as a clear leader. The one best suited to our particular situation."

The company that developed the system is Manure Systems Inc. of Abbotsford, British Columbia, Canada. Their Trident Nutrient Recovery System is one of the leading systems in the world, the result of 10-years of scientific research and farm-based development. To do it, they partnered with specialized equipment manufacturers, an ag science laboratory, and a specialty chemicals manufacturer. They were also able to have it included as an essential component in high profile manure management project of the University of Wisconsin-Madison².

NUTRIENT RECOVERY PROCESS

Trident began developing manure handling systems years ago, but the technology for capturing such a high percentage of nutrients is their most recent development.

"It's been a phased development process," explains Doyle. "Fifteen years ago, we designed the rotary screen manure separator. Then, we developed the know-how to pre-condition manure fiber and produce higher-quality bedding. The final phase has been combining the specific equipment and chemistry to process the remaining water effluent and recover the nutrients."

¹ Digestate is manure and/or other organic material that has passed through a digester.

² The Accelerated Renewable Energy Consortium, a partnership of the University of Wisconsin-Madison, Soil Net, LLC and Maple Leaf Dairy. Learn more at <http://bit.ly/1E4APy2>

Benefits of Trident's Nutrient Recovery for Dairy Farms

- **Recovered fiber** can be used for barn bedding or biomass feedstock.
- **Lagoon water volume** is reduced to 80%.
- **Lagoon water** has 98% less manure solids enabling improved irrigation methods.
- **Lagoon water** has 85% of the phosphorus and 50% of the nitrogen removed.
- **Lagoon cleanouts** are significantly reduced.
- **Captured solids (nutrient fertilizer)** can be stacked and dry stored.
- **Transport volume** of nutrient fertilizer is reduced by 75%.
- **Captured nutrients** can be spread with dry manure spreaders.
- **Total manure management costs** are reduced by as much as 25% or more.

That may sound simple, but it isn't. It was developed through years of trial and error. First, testing in the lab and then on real-world dairy farms. Central to the Trident process is a unique chemistry designed and formulated for manures and organic sludge by Dr. Aicardo Roa, an award-winning scientist from Wisconsin, whose company Soil Net develops the custom polymers.

"The Trident Nutrient Recovery System is a 3-step process," says Kerry Doyle, President and Founder of Manure Systems Inc. "We remove the big fiber and squeeze out the water, which makes biomass for bedding. We take the remaining sludge and float the fine solids (the nutrients) to the top. Those are skimmed off, dewatered and then pressed. The final output is two parts, a fertilizer-concentrate, compacted into a dry cake, and tea water, which is virtually depleted of nutrients."

"The chemistry was developed early on," continues Doyle. "But, it took years of trial and

error in the lab and on the farm to get the chemistry, equipment, and automation all balanced right for consistent results.”

THEY DON'T NEED DRINKING WATER

It wasn't just equipment and chemistry that contributed to the development. There was one primary principle understood from the very beginning: it had to be affordable. It was the principle understanding that industry adoption would be driven by the economics: it had to be cost-effective.

“One thing we knew from the start, industry adoption would be driven by the economics,” explains R.C. Ludke, one of the development partners and President of LEAP Tech, Inc. Leap Tech maps out the infrastructure for the system's materials process handling. They also build and program the computer-automated controls. “We had to make both the capital cost and the ongoing operating costs, fit with the reality of a dairy farmer's budget. We're sometimes asked if we can make drinking water. We can, but it's not really what farmers need and it pushes costs into the stratosphere.”

Other companies have nutrient recovery in development, some big ones too, but more often than not their systems have failed on farms. That's not always because their technology doesn't work, but because their economics doesn't.

Fair Oaks installed the Trident Nutrient Recovery System in April 2015. So, far the results are promising. McCloskey is impressed

with the delivery on promises that Manure Systems Inc. had made. “From the pilot to the budget, to the build, install, and ramp up, Kerry has made good on all of my expectations.

“Our total costs for manure operations has historically been between \$.50-0.75 per hundredweight (100lbs) of milk sold, which, I believe, is pretty much average for our industry,”



Stacked nutrient fertilizer with 85% of the phosphorous, 50% of the nitrogen, and 20% of the potassium captured.

says Dr. McCloskey. “Our expectation is that the Trident system as it affects the various component costs of our entire manure management ecosystem is going to bring our costs down by least one-third, so the economics look promising.”

Though, he hastens to add, “It's only been six months so the true measure will be known a year from now and we've been through a full year's cycle.” That said, his enthusiasm for the technology is clearly evident. “In this age of environmental sensitivities, manure operations is taking such an oversized slice of management's attention and the overall operational budget. If nutrient recovery can make that much difference, it will help bring

that entire equation back into balance. As managers, we believe nutrient recovery is another important tool for the industry to use in its environmental sustainability toolbox.”

And, if technology decisions of Fair Oaks have been any sort of harbinger for the direction of the industry, this one certainly speaks well for the future of nutrient recovery.

Richard Shatto is Sr. Partner of Point Nexus Consulting Inc., Abbotsford, BC Canada, a company that helps small business make better decisions.